

Solutions

2.1

Use sine because opposite and hypotenuse are given.

$$\theta = \sin^{-1} \left(\frac{o}{h} \right) = \sin^{-1} \left(\frac{6}{10} \right) \approx 36.9^\circ$$

Angle 36.9 degrees.

2.2

Multiply the degree measure by pi over 180.

$$\theta_{rad} = \theta_{deg} \frac{\pi}{180} = 150 \frac{\pi}{180} = \frac{5\pi}{6}$$

Exact answer $5\pi/6$ radians.

2.3

Pair each side with its opposite angle.

$$\frac{a}{\sin A} = \frac{b}{\sin B}$$

$$b = \frac{a \sin B}{\sin A} = \frac{8 \sin 65^\circ}{\sin 40^\circ}$$

Correct substitution or rearrangement.

$$b = \frac{8 \sin 65^\circ}{\sin 40^\circ} \approx 11.3 \text{ cm}$$

Correct length.

2.4

Use cosine rule because the angle lies between the known sides.

$$c^2 = a^2 + b^2 - 2ab \cos C$$

$$c = \sqrt{a^2 + b^2 - 2ab \cos C} = \sqrt{7^2 + 9^2 - 2(7)(9) \cos 60^\circ}$$

Correct substitution.

$$c = \sqrt{7^2 + 9^2 - 2(7)(9) \cos 60^\circ} = \sqrt{67} \approx 8.19 \text{ cm}$$

Correct third side.

3.1

(a) The east and north components are perpendicular.

$$d = \sqrt{e^2 + n^2} = \sqrt{4^2 + 3^2} = 5 \text{ km}$$

Distance 5 km.

(b) Measure clockwise from north, so east is opposite and north adjacent.

$$\beta = \tan^{-1} \left(\frac{e}{n} \right) = \tan^{-1} \left(\frac{4}{3} \right) \approx 53.13^\circ$$

Bearing 053 degrees.

(c) A reverse direction differs by 180 degrees.

$$\beta_{reverse} = \beta + 180^\circ \approx 53.13^\circ + 180^\circ = 233.13^\circ$$

Reverse bearing 233 degrees.

3.2

The near distance is $d - 10$ m. Both triangles share height h above instrument level.

$$h = d \tan 35^\circ$$

First equation.

$$h = (d - 10) \tan 50^\circ$$

Second equation. Equate the two expressions for h .

$$d \tan 35^\circ = (d - 10) \tan 50^\circ$$

Rearrange to isolate d .

$$d = \frac{10 \tan 50^\circ}{\tan 50^\circ - \tan 35^\circ}$$

$$d = \frac{10 \tan 50^\circ}{\tan 50^\circ - \tan 35^\circ} \approx 24.2 \text{ m}$$

Correct initial distance. Use the unrounded distance to find h .

$$h = d \tan 35^\circ \approx 16.9765 \text{ m}$$

Correct height above instrument level.

$$H = h + 1.5 \approx 16.9765 + 1.5 = 18.5 \text{ m} \quad (3 \text{ s.f.})$$

Total height. Both observations use the same instrument level; 1.5 m is one offset from that shared horizontal line to the ground.